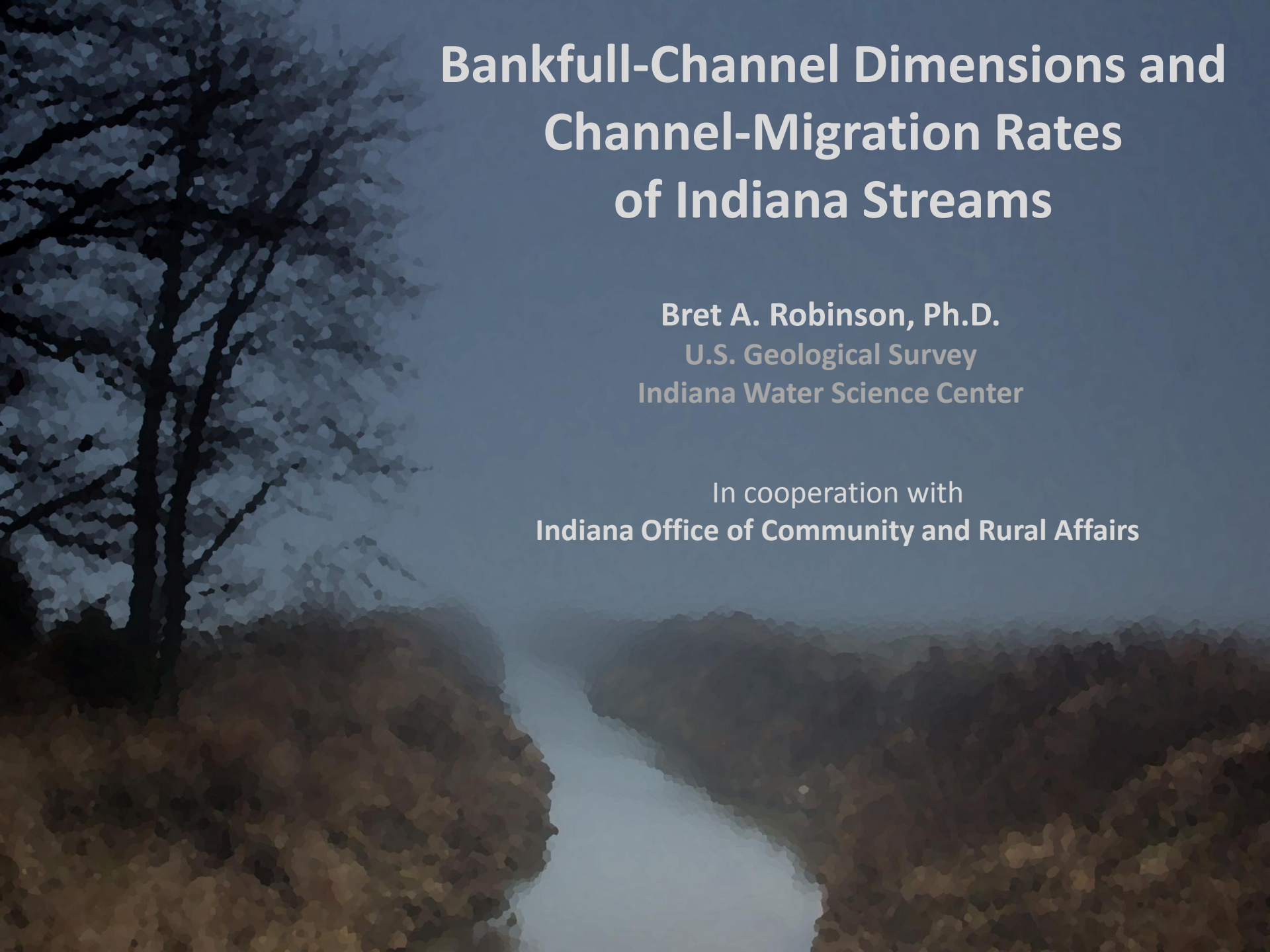


# Bankfull-Channel Dimensions and Channel-Migration Rates of Indiana Streams

**Bret A. Robinson, Ph.D.**
U.S. Geological Survey
Indiana Water Science Center

In cooperation with
**Indiana Office of Community and Rural Affairs**

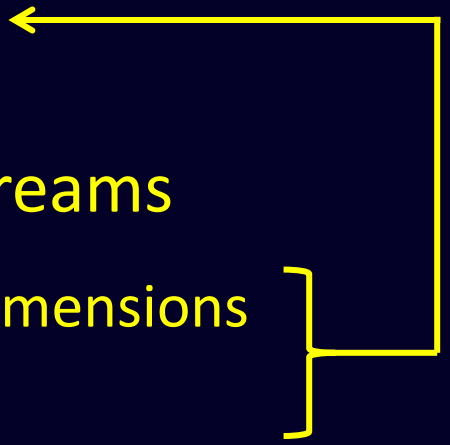
# Outline of Slides

## Introduction to Fluvial Erosion Hazards (FEH)

- Lateral channel migration images
- Lateral channel migration impacts
- Indiana's FEH program

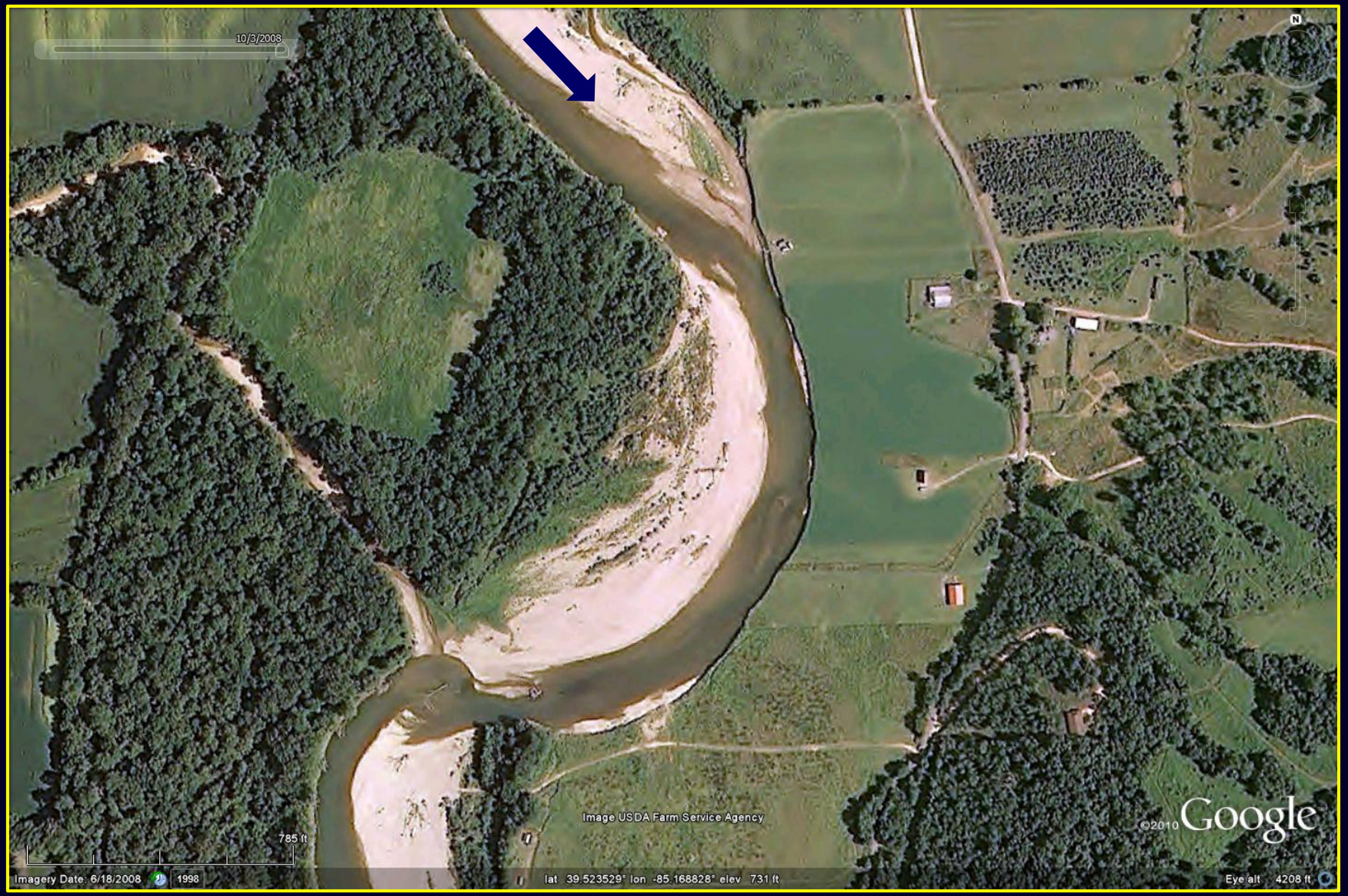
## Two USGS tools for Indiana streams

- Regional bankfull-channel dimensions
- Channel-migration rates



USGS

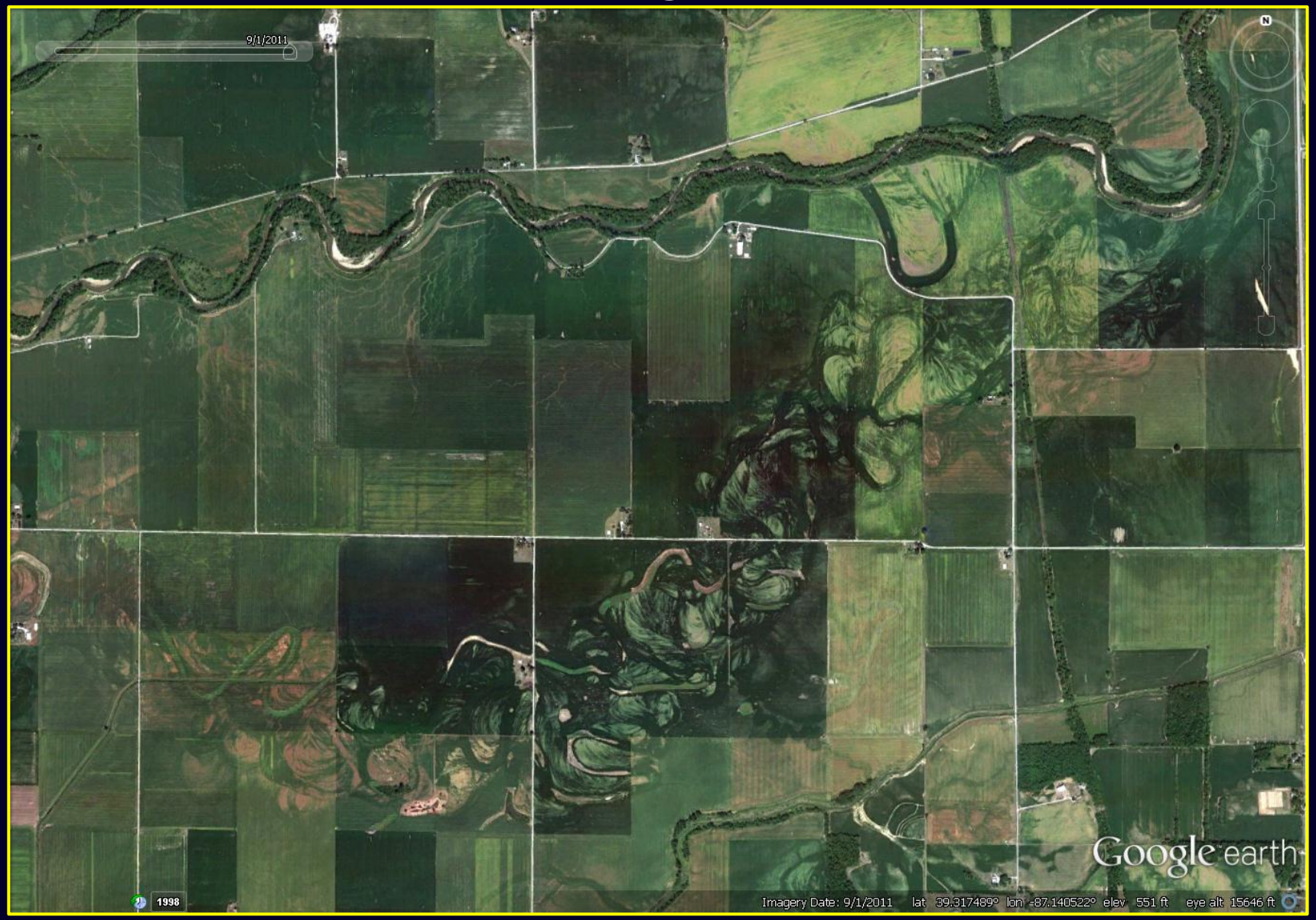
# Lateral channel-migration




Whitewater River near Metamora, Ind.

USGS

# Lateral channel migration —Continued




Eel River near Clay City, Ind.

USGS

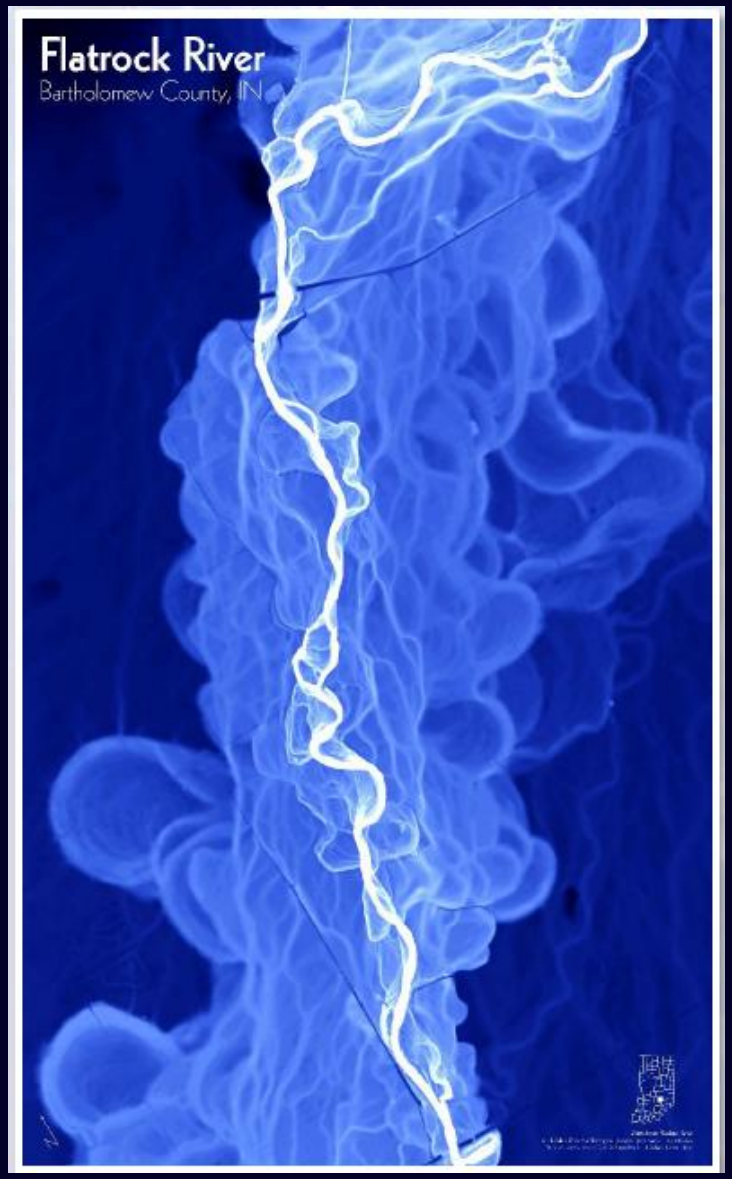
# Lateral channel migration —Continued

## LiDArt

created by

Matt Johnson

Indiana Geological Survey




USGS

# FEH Impacts

East Fork White River near Brownstown, Ind.

## Ag-land Loss

Little Raccoon Creek near Ladoga, Ind.

USGS

# Residential Property Loss

Honey Creek at Smith Valley, Ind.

# Threats to infrastructure


USGS

Google Earth™

# Bridge Failures

(Rare)

Troy Ave at Buck Creek, 1991

Keystone Ave at Haverstick Creek, 2011

Indianapolis, Ind.

USGS

# Indiana's FEH Program


**Indiana Silver Jackets**

Program direction discussions

## FEH Study Team

Indiana Univ. / Purdue Univ. at Indianapolis (IUPUI)

- Center for Earth and Environmental Science → Education / Outreach
- The Polis Center → FEH Mapping

U.S. Geological Survey → Science Tools

- Bridge Screening
- Bank assessments
- StreamStats updates
- Bankfull Indicators
- Bankfull dimensions
- Migration rates

USGS

# Remaining slides…

Two U.S. Geological Survey reports

## Scientific Investigations Report 2013-5078

Regional bankfull-channel dimensions of Indiana streams

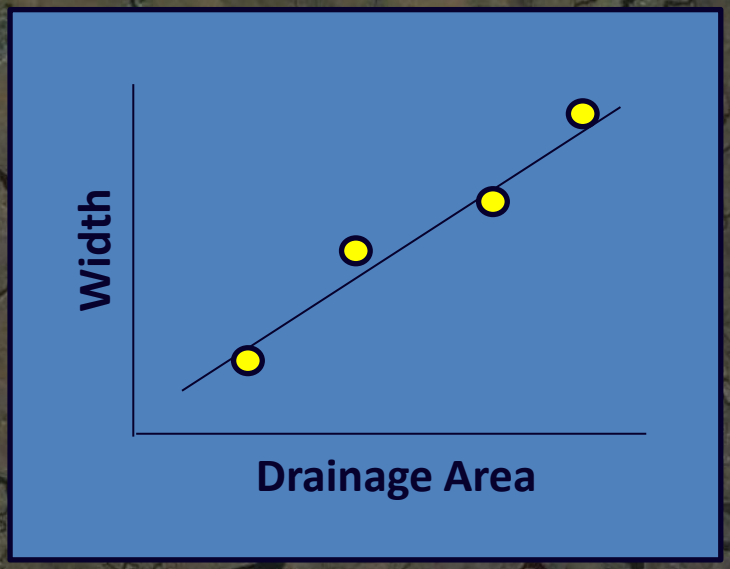

## Scientific Investigations Report 2013-5168

Channel-migration rates of selected Indiana streams


USGS

Barnett Creek at Lower Suwannee National Wildlife Refuge, Fla.

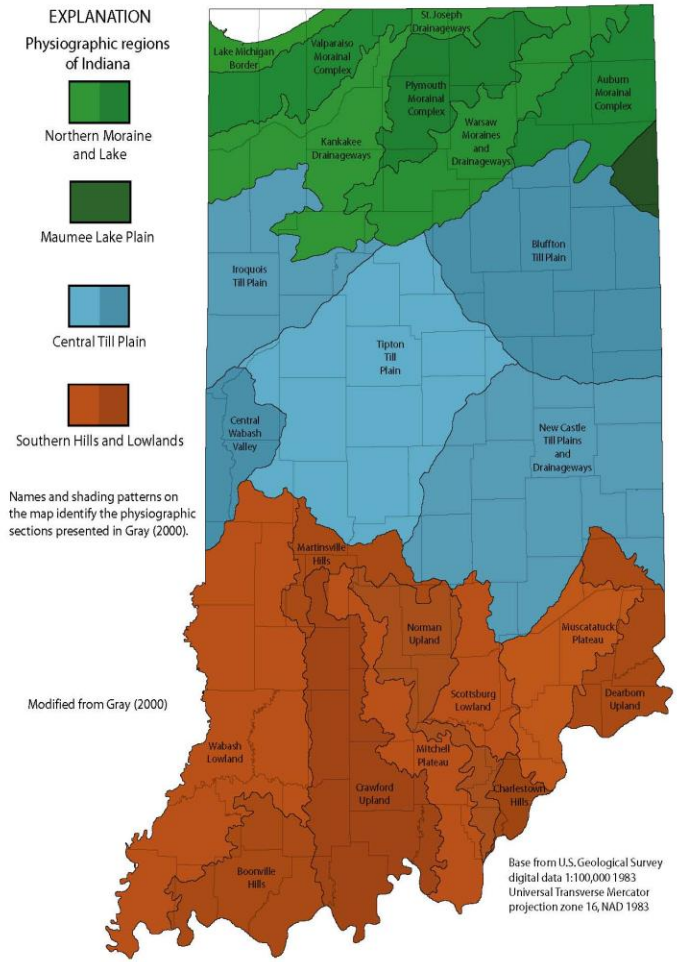
# Channel Dimensions = $f$(Drainage area)






USGS

# Physiographic Divisions of Indiana



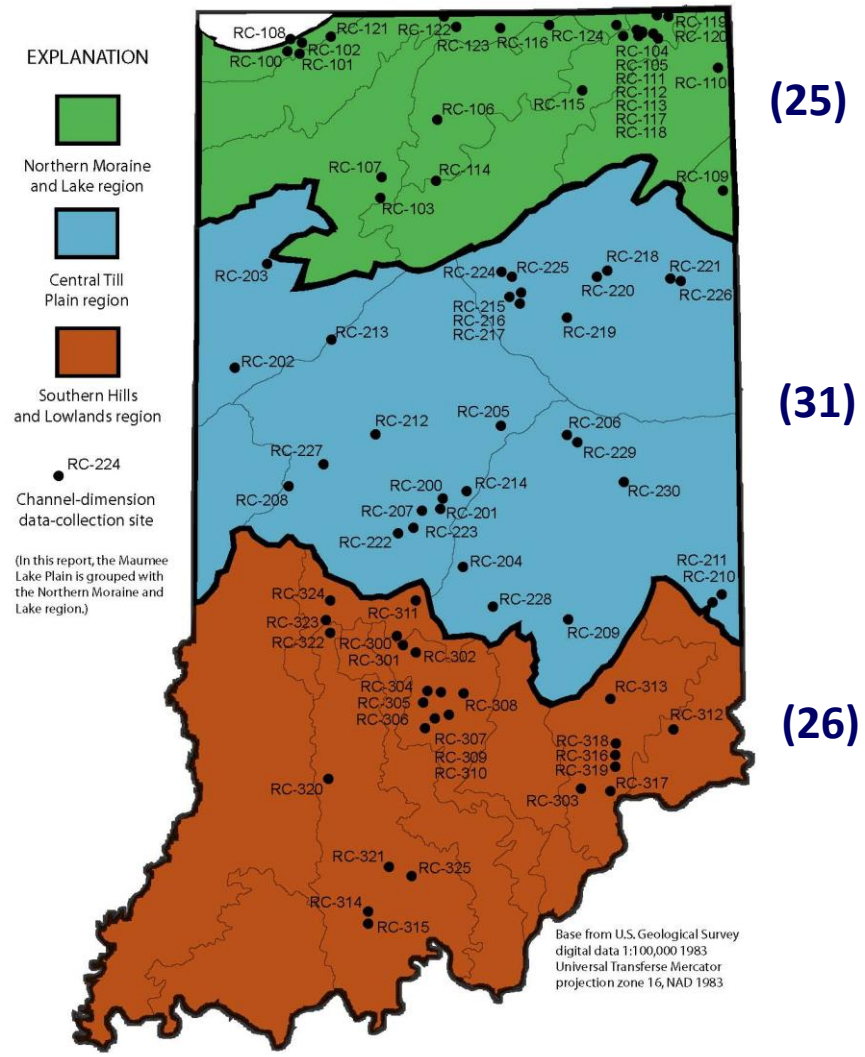

Henry Gray, 2000
Indiana Geological Survey
Special Report 61

## Northern Indiana Streams

## Southern Indiana Streams

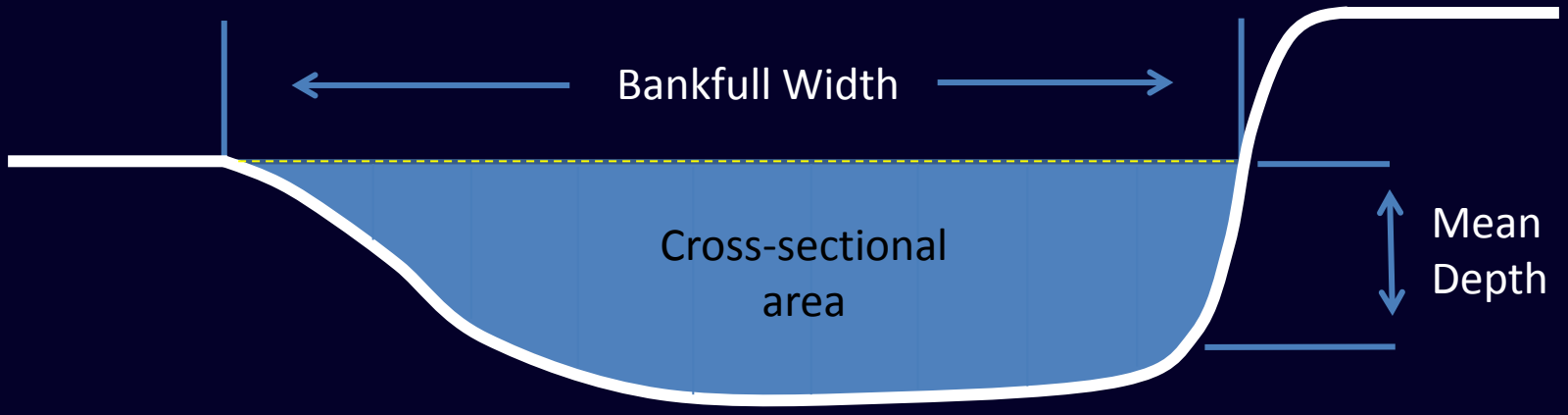
USGS

# 82 Data-collection sites



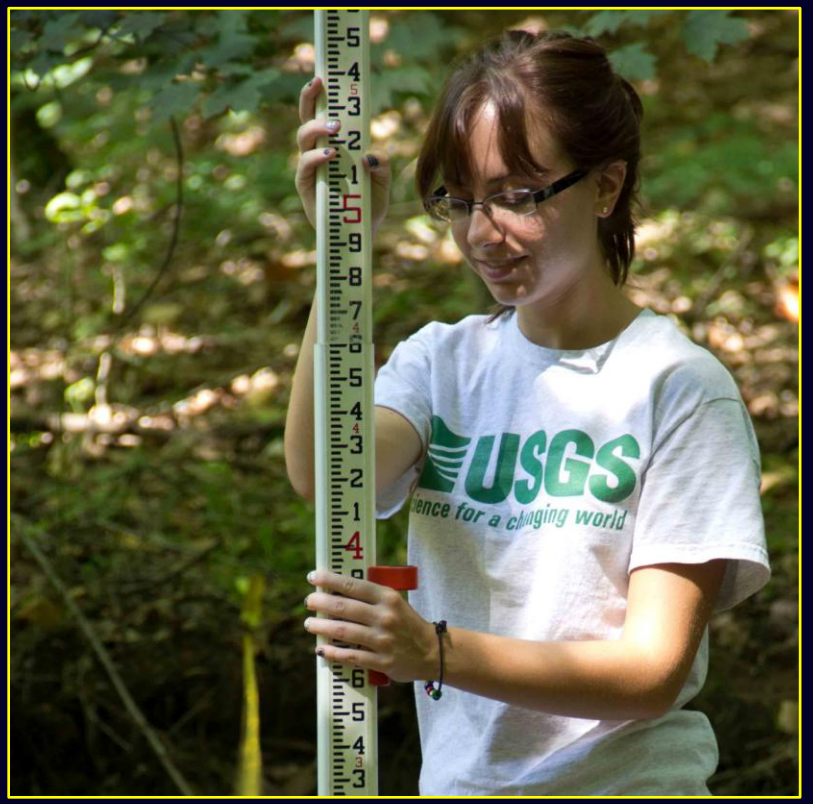

USGS


# Data Elements



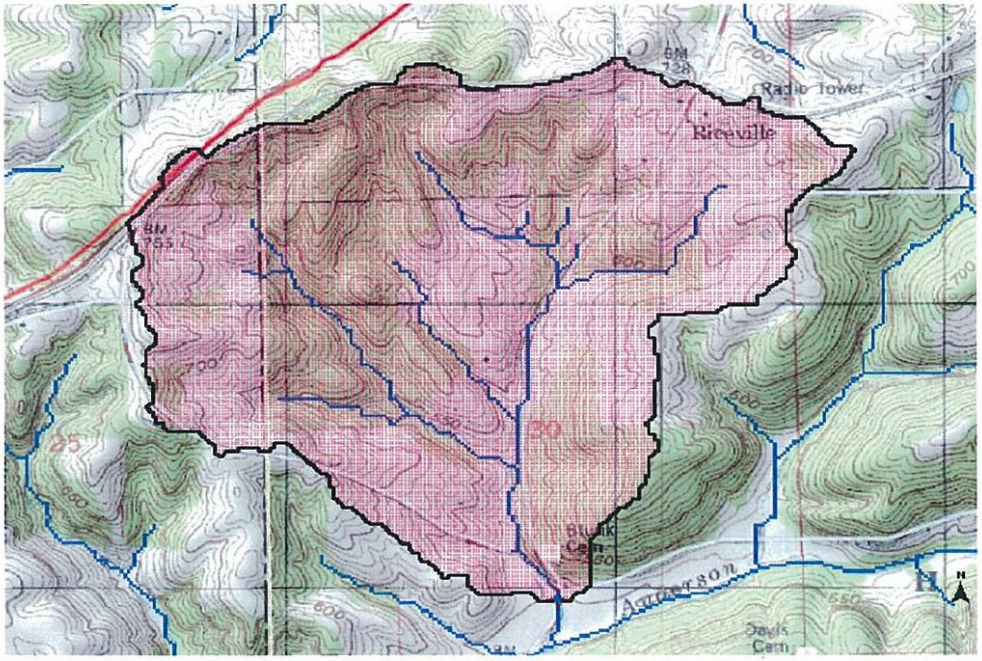

USGS

# RC-314 Unnamed tributary to Anderson River




USGS
Indiana StreamStats

**StreamStats Print Page**




USGS
Indiana StreamStats

## Basin Characteristics Report

**Date: Mon Jul 15 2013 06:35:15 Mountain Daylight Time**
**NAD27 Latitude: 38.3091 (38 18 33)**
**NAD27 Longitude: -86.6703 (-86 40 13)**
**NAD83 Latitude: 38.3091 (38 18 33)**
**NAD83 Longitude: -86.6703 (-86 40 13)**

| Parameter | Value |
|---|---|
| Total drainage area in square miles | 1.007 |

# Regional Curves

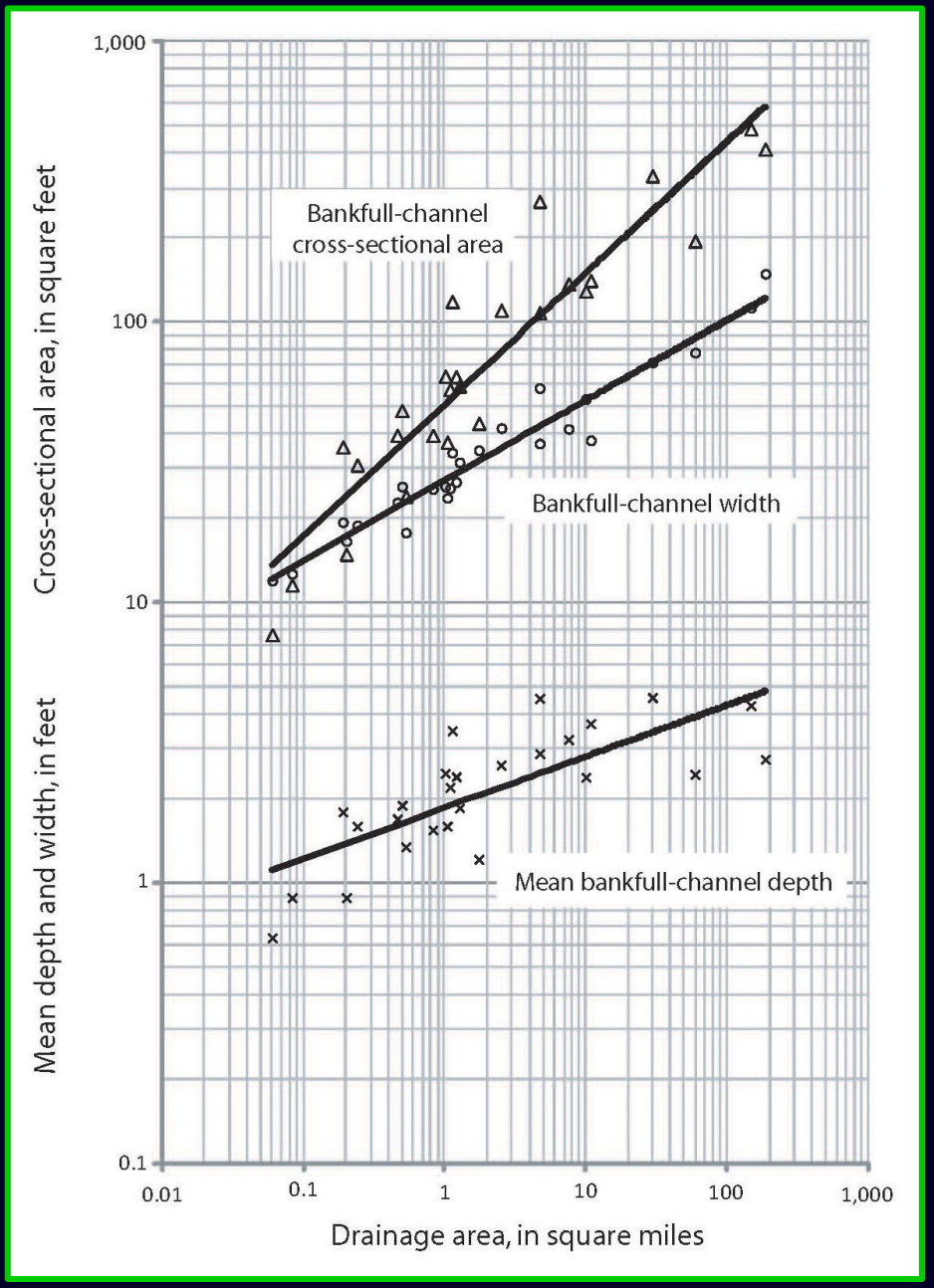
Plots →

Regression equations ↓

**Table 5.** Regression equations for estimating bankfull-channel dimensions of non-urban wadeable streams in Indiana.

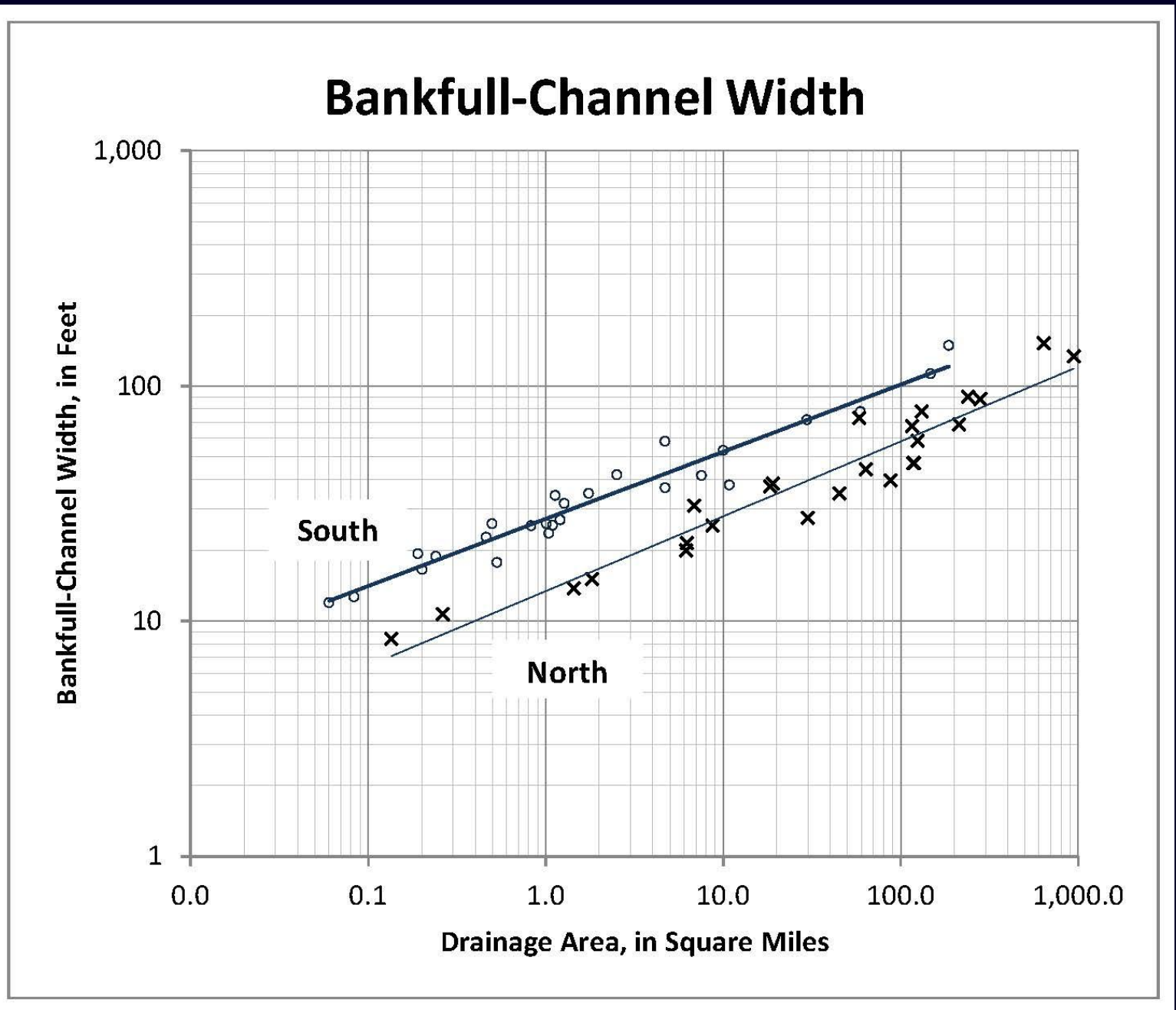
[WBF, bankfull width, in feet; DBF, mean bankfull depth, in feet; ABF, bankfull cross-sectional area, in square feet; DA, drainage area, in square miles]

| Equation number | Equation | Coefficient of determination (r-squared) |
|---|---|---|
| | Northern Moraine and Lake region | |
| 1 | $WBF_n = 13.4\ DA^{0.318}$ | 0.92 |
| 2 | $DBF_n = 1.3\ DA^{0.176}$ | 0.75 |
| 3 | $ABF_n = 17.0\ DA^{0.495}$ | 0.92 |
| | Central Till Plain region | |
| 4 | $WBF_c = 18.2\ DA^{0.327}$ | 0.94 |
| 5 | $DBF_c = 1.6\ DA^{0.159}$ | 0.56 |
| 6 | $ABF_c = 28.8\ DA^{0.487}$ | 0.88 |
| | Southern Hills and Lowlands region | |
| 7 | $WBF_s = 27.2\ DA^{0.286}$ | 0.94 |
| 8 | $DBF_s = 1.9\ DA^{0.183}$ | 0.58 |
| 9 | $ABF_s = 50.9\ DA^{0.468}$ | 0.87 |




South

USGS


Bankfull-Channel Width
1,000
100
10
1
Bankfull-Channel Width, in Feet
South
North
0.0
0.1
1.0
10.0
100.0
1,000.0
Drainage Area, in Square Miles

USGS

Report available at
USGS
Publications Warehouse

Results available in
StreamStats

USGS

Prepared in cooperation with the Indiana Office of Community and Rural Affairs

# Regional Bankfull-Channel Dimensions of Non-Urban Wadeable Streams in Indiana

By Bret A. Robinson

Pleasant Run Creek at Greenwood, Indiana. (Photograph by Bret A. Robinson, U.S. Geological Survey, taken January 24, 2013)

Scientific Investigations Report 2013—5078

U.S. Department of the Interior
U.S. Geological Survey

To view this report, visit:
http://pubs.usgs.gov/sir/2013/5078/

USGS

# Indiana Streams…

## Actively Migrating….

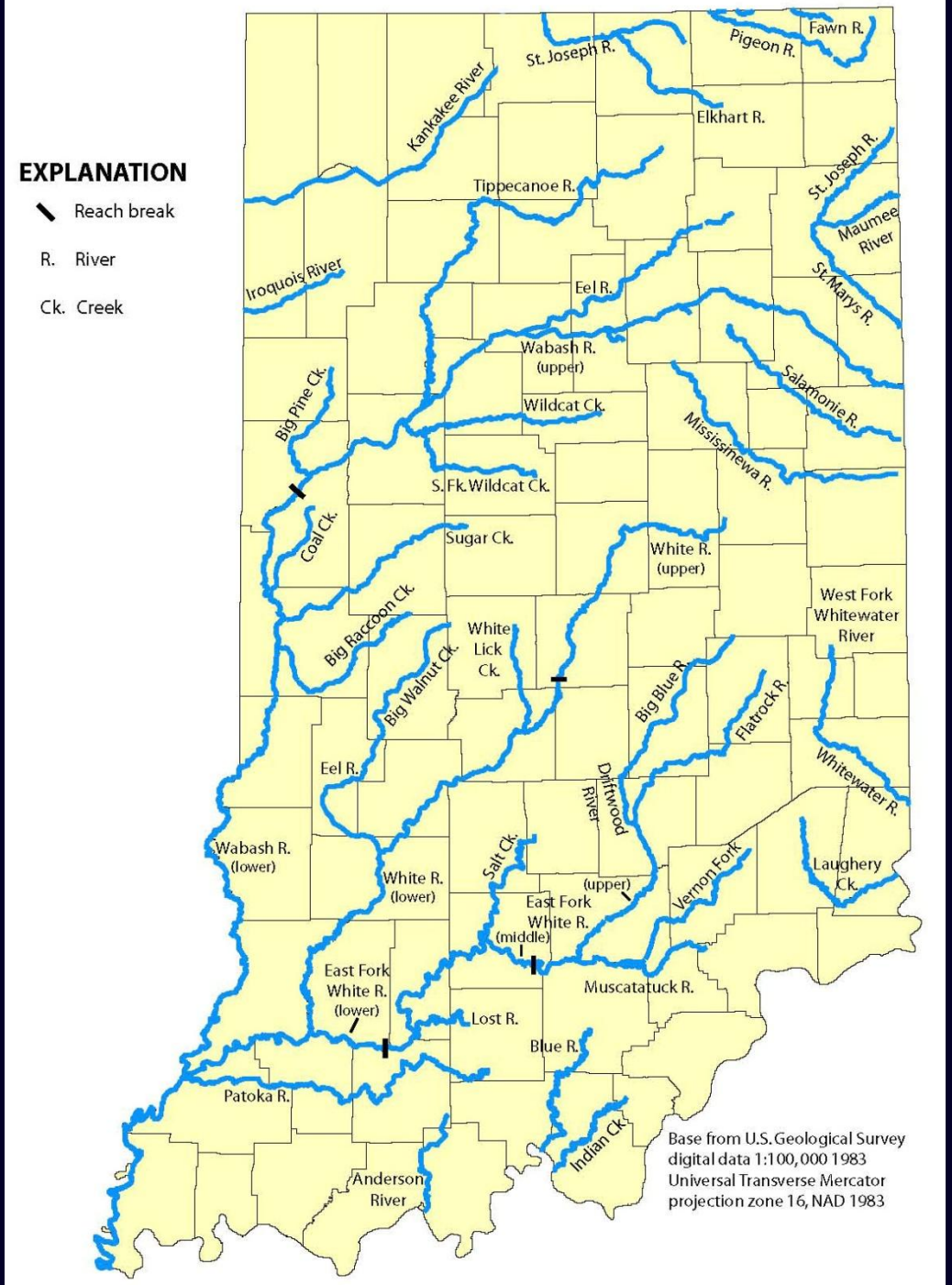
- Raw and failing cutbanks
- Non-vegetated point bars

## Recently Stationary….

- Both banks stable
- With mature trees

USGS

# Channel-migration rates?



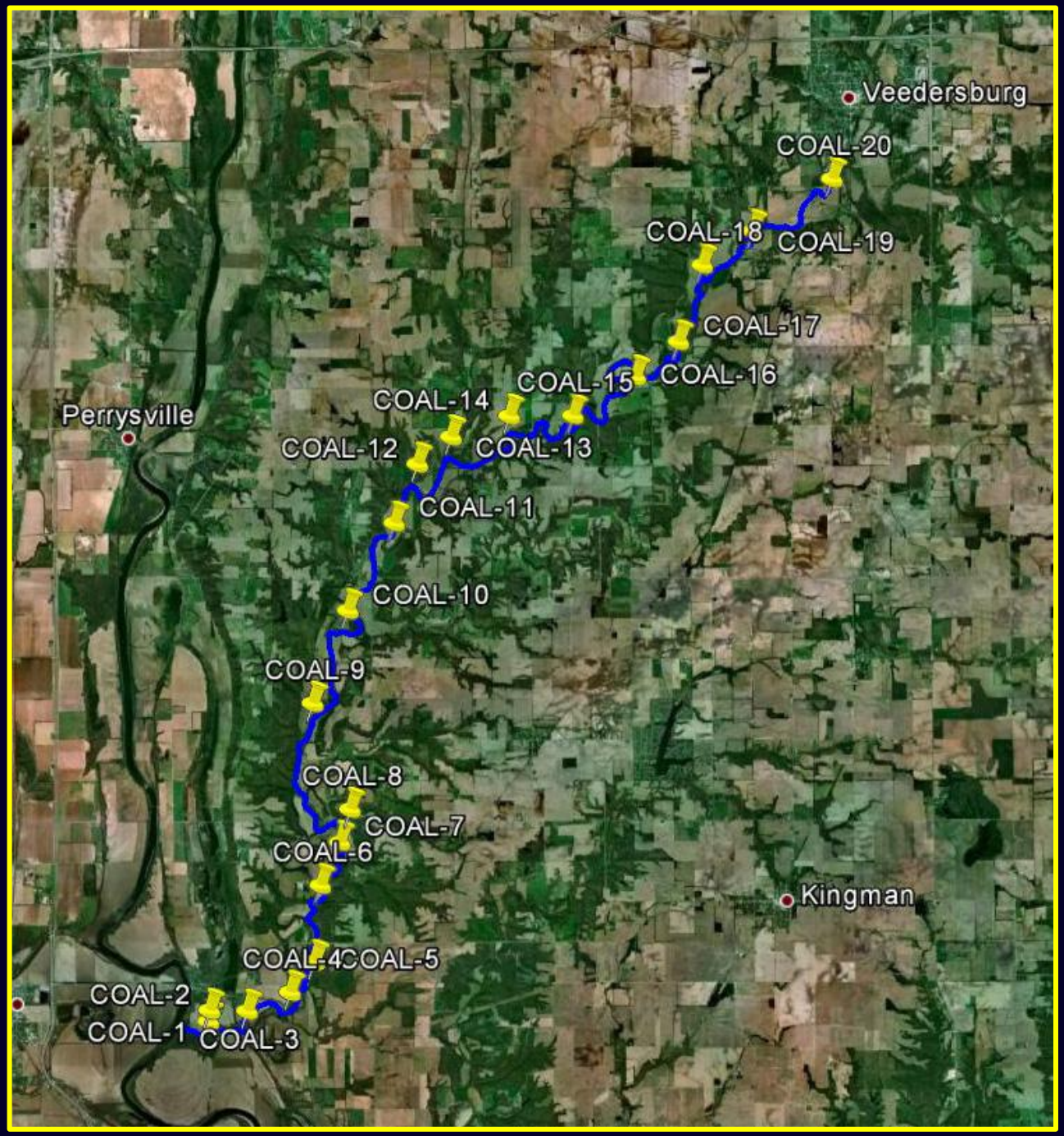

USGS

# Coal Creek

from
Mouth to Veedersburg

Coal-1
Coal-2
Coal-3

Coal-20




USGS

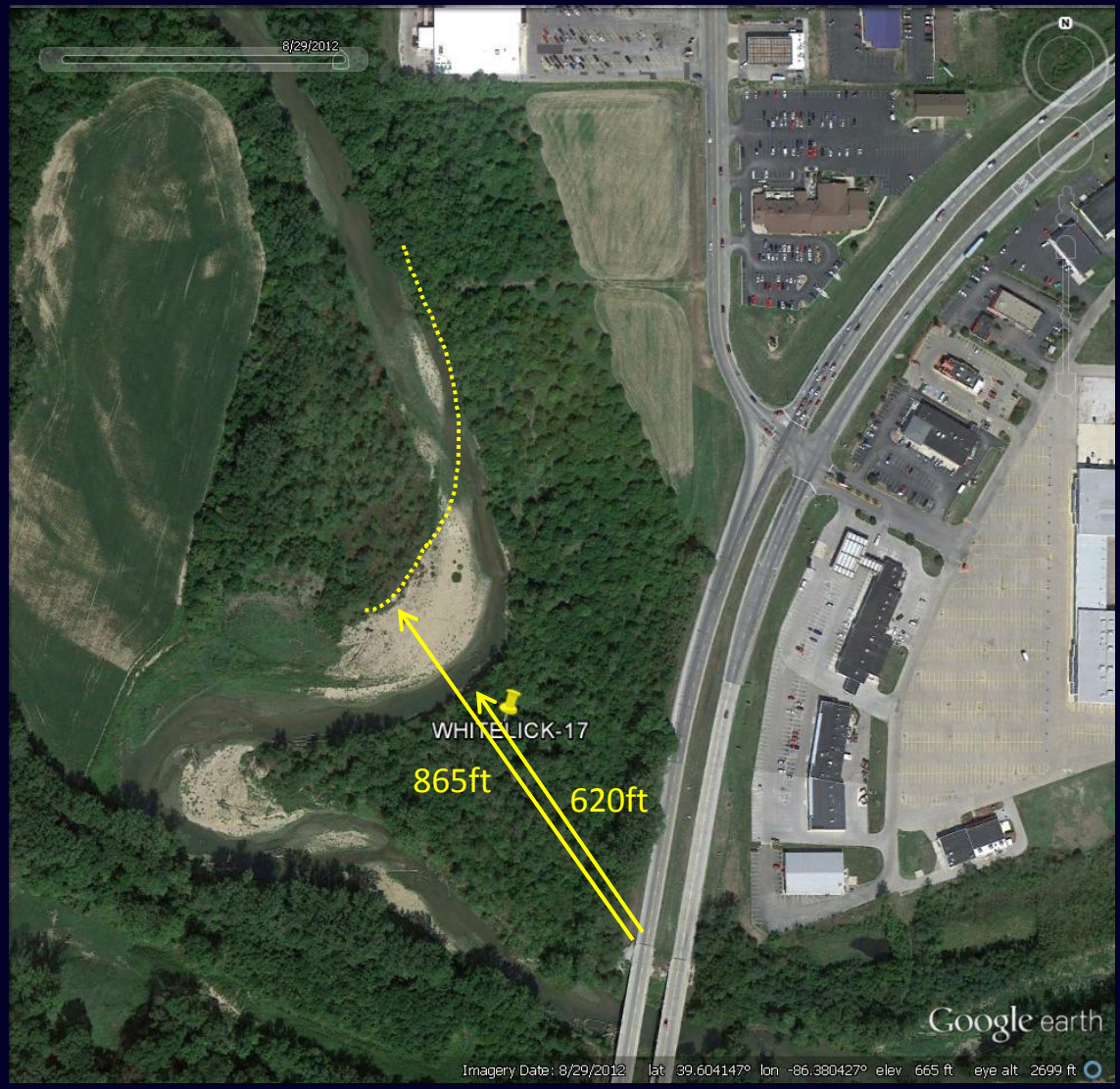
# At each selected meander…..

White Lick Creek at Mooresville, Ind. (WHITELICK—17)

Historical imagery: 1998 to 2012

$$12\left(\frac{865\text{ ft} - 620\text{ ft}}{172\text{ months}}\right) = 17\text{ ft/yr}$$

(…over the past 14 yrs)




April, 1998

Aug, 2012

USGS

# Some meanders are relatively stationary…

Tippecanoe River
(TIPPY-2)

Rate <1 ft/yr

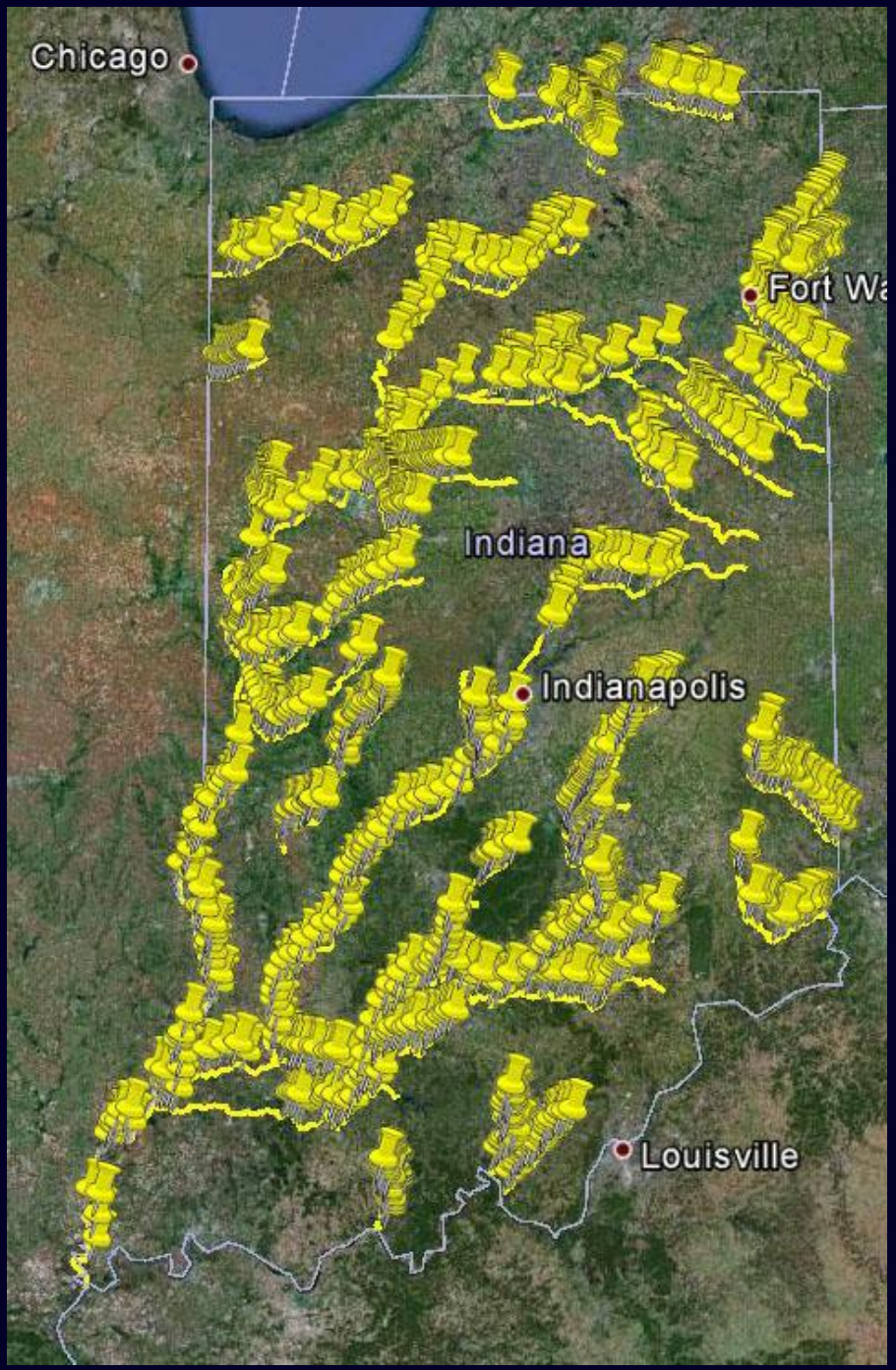
March, 1992
Feb, 2012
(…20 yrs)


USGS

# Within Indiana

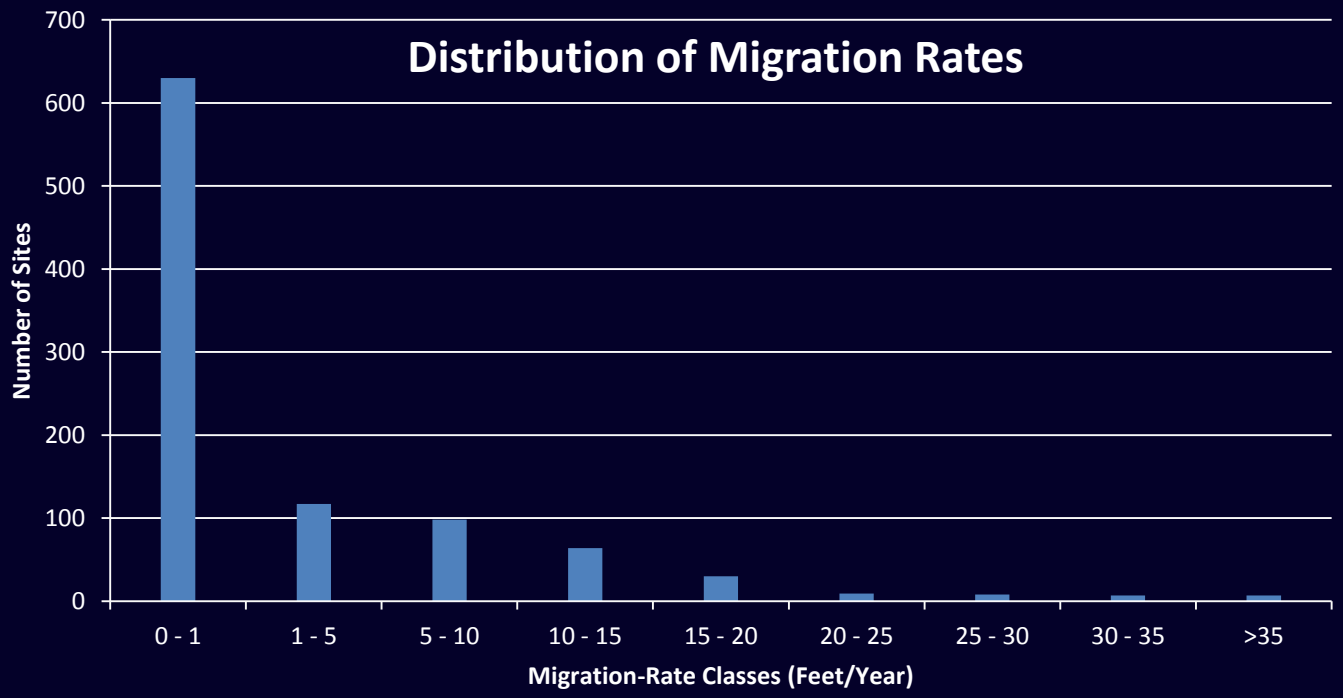
Investigating 38 largest streams

970 meanders measured




USGS

# Summary Statistics




- 65% of measured sites are stationary
- 85% of measured sites migrating <10 ft/yr
- 3% of measured sites migrating >20 ft/yr

USGS

# Determine 75th Percentile

| Site | Rate (ft/yr) |
|---|---|
| COAL-7 | 7.7 |
| COAL-19 | 7.6 |
| COAL-1 | 6.1 |
| COAL-15 | 5.3 |
| COAL-17 | 4.7 |
| COAL-8 | 4.4 |
| COAL-18 | 4.4 |
| COAL-3 | 4.2 |
| COAL-6 | 4.1 |
| COAL-11 | 3.8 |
| COAL-9 | 3.4 |
| COAL-10 | 3.1 |
| COAL-5 | 3.1 |
| COAL-2 | 1.9 |
| COAL-20 | 1.7 |
| COAL-4 | 1.2 |
| COAL-12 | <1.0 |
| COAL-13 | <1.0 |
| COAL-14 | <1.0 |
| COAL-16 | <1.0 |

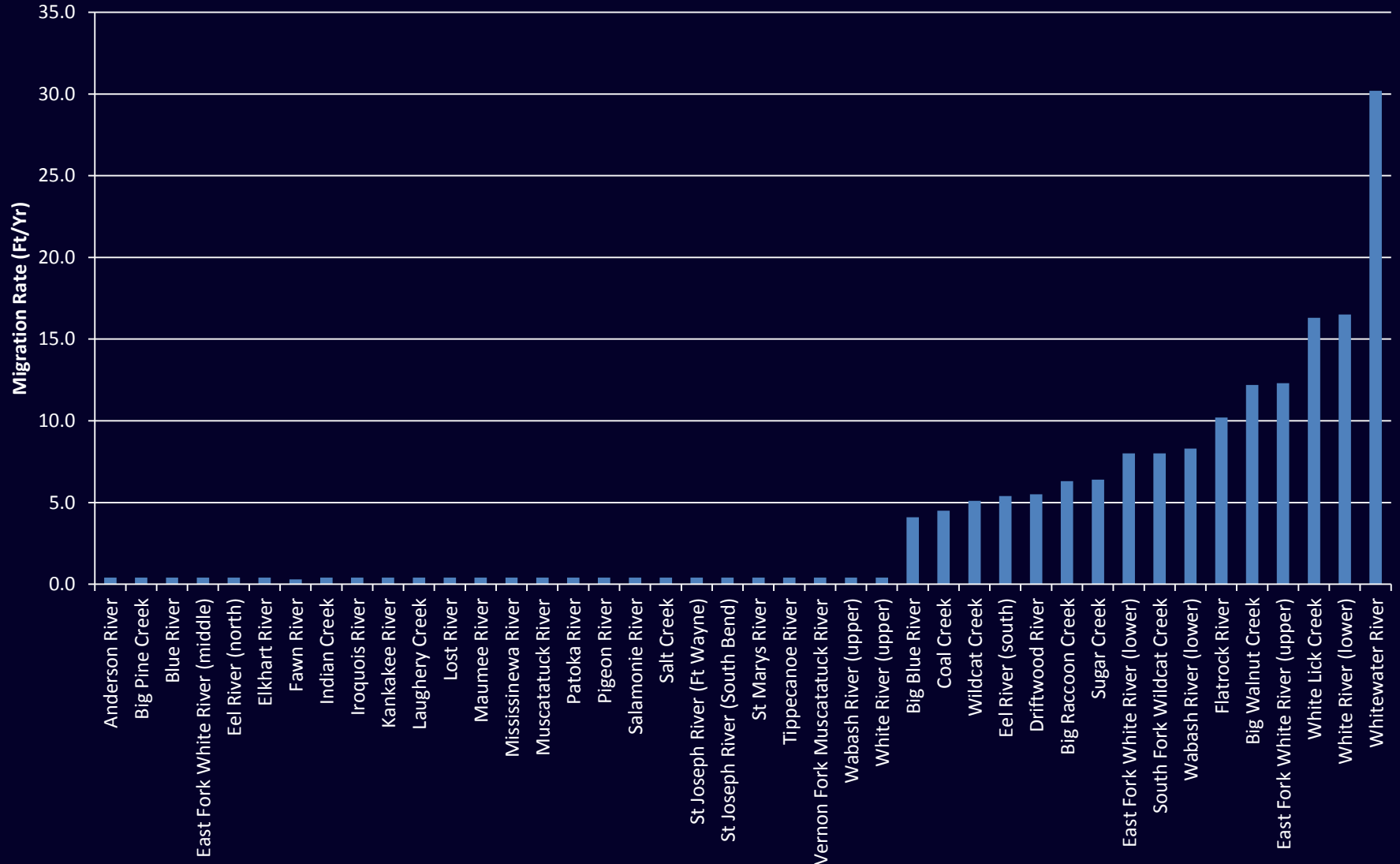
(25% are greater than…)

Coal Creek = 4.6 ft/yr

75% are less than…

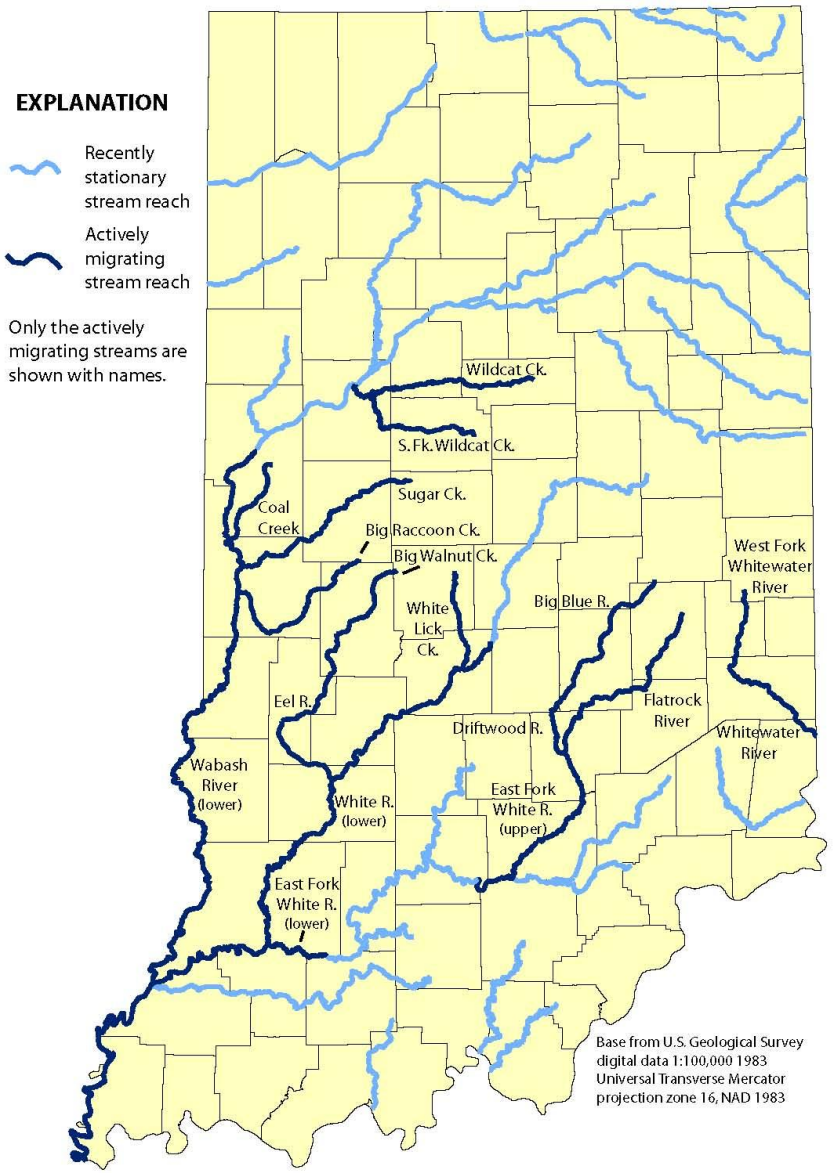
USGS

# 75th Percentile Channel-Migration Rates




USGS

Distribution of stationary and actively-migrating streams




USGS

USGS

Prepared in cooperation with the Indiana Office of Community and Rural Affairs

# Recent (circa 1998 to 2011) Channel-Migration Rates of Selected Streams in Indiana

By Bret A. Robinson


Google Earth™ images of White River near Centerton Ind., 2005 and 2012. The position of the channel relative to local landscape features allows for the recognition of recent channel migration.

Scientific Investigations Report 2013—5168

U.S. Department of the Interior
U.S. Geological Survey

To view this report, visit:
http://pubs.usgs.gov/sir/2013/5168/

USGS

# FEH Program in Indiana


## Science Tools (2/6)

- Channel-dimension curves
- Channel-migration rates


FEH Avoidance Mapping


Presentations
&
Workshops

# Questions?

- Indiana's FEH Program
- Regional Bankfull-Channel Dimensions
- Recent Channel-Migration Rates

Photograph: Terri Cooper, USGS